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THE DEVELOPMENT OF A TUNICATE WITHOUT NERVES, . . *Ida H. Hyde.*

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The Development of a Tunicate Without Nerves.

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A PRELIMINARY report is here presented of experimental work that deals with the differentiation of cardiac and other tissue independent of nervous control.

The organism employed was Ammarœcia, one of the Tunicates found in Woods Hole. It is viviparous, bearing the different stages of embryos in a definite sequence in the ova sack. When the notochord and motile tail are developed the larva swims out. It is active for about one hour, then attaches itself to the dish by means of its adhesive papillæ. In three days the heart begins to beat, and in four days the tail is absorbed and the organism is quite well developed. The nervous system, consisting of a vesicle formed of nerve cells and fibers, contains two pigmented sense organs. It functions before the pharynx, digestive system, and heart do.

In embryos the anlage of the tail, nervous system, and digestive tract can be recognized by the different-colored cells and their position.

For experimental purposes the embryos of different ages were easily dissected from the ova sack with fine steel points or hard glass fibers. Methylene blue and many other nerve

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stains and fixatives were employed in preparing the material for histological study, and camera drawings were made of some of the specimens.

At present only five sets of experiments were pursued, and for these controls were kept.

1. From a free-swimming larva the entire tail, with its notochord, nerves, muscles and tunic, was removed.

2. From young embryos the anlage of the tail was dissected.

The results from these two sets of experiments were that the organisms developed quite normally, but were smaller than the normal control.

3. Removed from a free-swimming larva the tail and also the nervous system with its sense organs.

4. Removed from young embryos the anlage of the tail and the nervous system, staining them, as well as the control, after four days with methylene blue.

The results from these two sets of experiments were that they developed much smaller than the control, many were abnormal, and in four or five days the heart began to beat and the siphons contracted when touched. The contractions were slower and not as complete as in the control, and at this time I can not state positively that the heart reverses its rhythm spontaneously.

5. Removed the nervous system and the heart anlage from young embryos. In some only part of the nervous system had been removed, as shown by the methylene-blue staining. The resulting cell complex developed into an abnormal structure devoid of heart and siphons, and with an incomplete digestive system. In those that retained part of the nervous system and pharyngeal cells, only one siphon developed. In others, in which the nervous system and part of the pharyngeal cells were removed but not the heart anlage, the structure regenerated its tunic, which contained, after four days, an abnormally formed digestive tract with a beating heart and one siphon.

We may conclude: that the cells which give rise to the heart, siphon and digestive tract continue to develop after the nervous system has been removed; the cells are independent living structures, capable of continuing their growth in a suitable

environment, to a certain stage, but act slower and less completely to stimuli than they do in their normal coöperative medium; the fragmentary organism that is left forms an abnormal structure, with a protective tunic; the heart will beat and muscles differentiate without the presence of the nervous system.

Hooker, Harrison, Goldstein Shaper, Burrows, Carrel and others have worked on problems similar to mine. Their work will be discussed in the final paper.